British, presented by Mrs. Herbert Morris; four Yellow-bellied Liothrix (*Liothrix lutens*) from China, presented by Mr. Albert Kettich; a Black-billed Sheathbill (*Chionis minor*), captured at sea, a Water Rail (*Rallus aquaticus*), British, presented by Mr. John Gunn; a Lineolated Parrakeet (*Bolborhynchus lineolatus*) from Mexico, presented by Mr. Edward Hawkins; a Puff Adder (*Vipera arietans*) from South Africa, presented by Mr. J. E. Matcham; a Lear's Macaw (*Ara leari*) from South America, four White-backed Pigeons (*Columba leuconota*) from the Himalayas, a Rock-hopper Penguin (*Eudyptes chrysocome*) from New Zealand, deposited; two Alpine Choughs (*Pyrrhocorax alpinus*), European, purchased; an English Wild Cow (*Bos taurus*, var.), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

Relative Densities of Terrestrial Planets.—Attention is drawn to an interesting relation between the diameters and densities of the terrestrial planets, by E. S. Wheeler (*Science*, April 19). The planets are plotted with their diameters in miles as abscissæ, and their densities (the earth being taken as unity) as ordinates, and it is then seen that the points located in this way lie approximately in a straight line. Such a line passes within the limits of the probable errors of all except Venus. If this relation should prove to represent a natural law, the mass of a planet or satellite could be determined from its diameter. Venus is the only one of the five planets (the moon being included) that is any more discrepant than might be expected from its probable error; to make it accordant, either its mass must be increased by one-tenth, or its diameter decreased by one-thirtieth. A sufficient increase in the mass of Venus is stated to be all that is necessary to explain the movement of the perihelion point of the orbit of Mercury; but some of the irregularities of Mercury may be accounted for by the small mass which it is now supposed to have, namely, one-thirtieth that of the earth. In plotting the planetary curve, the density of Mercury adopted, is that derived by Backlund from a discussion of the movements of Encke's comet.

The Orbit of Comet 1893 IV (Brooks).—An investigation of the path of this comet, by Signor Peyra, seems to suggest that it is one of a series travelling in the same elliptic orbit (*Ast. Nach.* No. 3281). This conclusion is based on the similarity of the orbit with those of comets 1864 I and 1822 I, the periods of the comets rendering actual identity impossible. The elements of the orbit are as follows:

T = 1893 Sept. 19·25954 Berlin M.T.

	°	′	″	
Longitude of perihelion	162	22	19	1893
,, ,, node ...	174	55	12	
Inclination	129	50	14	
Eccentricity	0·9964886			
Log *q*	9·909551			
Period	3516 years.			

The Spectrum of Mars.—A very practical contribution to the recent discussion as to the spectroscopic indications of aqueous vapour in the atmosphere of Mars is afforded by the investigations of Mr. Jewell as to the amount of vapour necessary to produce effects which can be observed with instruments of specified power. (*Astrophysical Journal*, April.) Expressing the amount of vapour present in the air of Baltimore by the depth in inches of a layer of water, the observed monthly mean for January is 0·73, June 3·25, October 1·56, the maximum occurring in June. He concludes that "unless the amount of water in the atmosphere of Mars is greater than that in the earth's atmosphere in October at Baltimore, it is useless to look for the presence of water vapour in the spectrum of Mars, unless our instrumental means are much superior to any hitherto used for that purpose." Since instruments of greater dispersion are unsuitable, because of the lack of sufficient light, there seems but little chance of obtaining any very decisive direct evidence of the presence of water vapour in Mars. It will be remembered that Dr. Janssen and others satisfied themselves as to the indications of water vapour bands in the spectrum of Mars, whilst Prof. Campbell has more recently failed to detect them.

The chances of detecting the presence of oxygen, however, if present, do not seem so hopeless, as the B group is readily seen with small dispersion.

It is also suggested by Mr. Jewell that attempts should be made to observe the chlorophyll bands in the spectrum of the green areas of the planets, since one of the bands is quite strong in the vegetation spectrum.

The Astronomical Society of France.—During the eight years of its existence, this Society has attained a membership of nearly 1000. At the annual meeting held recently, Dr. Janssen was elected president, and M. Camille Flammarion general secretary for the current session. The progress of astronomy in 1894 formed the subject of an address by M. Tisserand, the Director of the Paris Observatory. Among other matters he referred to the reappearance of De Vico's comet (Nature, vol. li. p. 542), which he regarded as further evidence of the fact that, at certain epochs, comets are subject to increases of brightness which they are incapable of maintaining, the increased activity being probably due to internal disturbances, the nature of which are not yet understood. It will be remembered, however, that Mr. Lockyer explains these fluctuations in brilliancy by collisions with meteor-swarms lying in the track of the comet. Referring to minor planets, M. Tisserand believed it not improbable that those appearing as bright as 12th magnitude stars have an average diameter of about 130 kilometres; that is, about one-hundredth of the earth's diameter; at that rate, even a thousand of them would not have a total mass equal to a thousandth part that of the earth, assuming that their mean density is not greater than that of the earth. (*Bull. Mens. Soc. Ast. de France*, May.)

THE ROYAL SOCIETY CONVERSAZIONE.

THE annual Royal Society conversazione, to which gentlemen only are invited, was held in the Society's rooms on Wednesday of last week.

Many branches of science were represented in the exhibits, either by apparatus or by results of research. An exhibit that attracted much attention was the electrical furnace as used for the melting of chromium, titanium, platinum, and other metals, with high melting-points, shown by Prof. Roberts-Austen, C.B. The furnace consisted of a fire-clay case lined with magnesia, and contained a magnesia crucible. The carbon poles were horizontal, the arc being deflected by means of a magnet on to the material to be heated. For purposes of exhibition, an image of the molten contents of the furnace was projected, by means of a lens and mirror, on to a screen; the current employed is usually about 60 or 70 amperes at 100 volts.

Some very valuable metals of the platinum group were exhibited by Messrs. Johnson, Matthey, and Co., among them being a platinum nugget, weighing 158 ozs.; palladium ingot, of 1000 ozs.; rhodium ingot, 72 ozs.; osmium, melted and sponge; ruthenium melted by the electric arc; and pure iridium rolled sheet.

A magnet, showing the effects of currents in iron on its magnetisation, was exhibited by Dr. Hopkinson. A large electromagnet had buried in its substance two coils of comparatively small dimensions, one around the centre of the magnet, the other half-way between the centre and the surface. These coils were connected to two galvanometers. On reversing the current round the magnet it was seen that a considerable time elapsed before either galvanometer showed any substantial current, and that the current in the central coil occurred much later than in that at a less depth in the mass of iron.

Prof. J. A. Fleming showed a synchronising alternating current motor and contact maker, for the delineation of the form of alternating current and electromotive force curves, and a form of resistance of small inductance for use with the apparatus.

An instrument for analysing primary and secondary volts and amperes simultaneously was exhibited by Prof. W. M. Hicks.

Mr. R. E. Crompton had on view electrically heated apparatus, showing the method of applying electricity for heating tools and appliances used in trade; also for domestic purposes. Wires of high resistance composed of nickel, steel, or other suitable alloys, were embedded in an insulating enamel, and by it attached to the various articles to be heated. By this means loss of heat was obviated. Connection was made with the circuit by means of safety connectors, in which the contacts were automatically protected. The perfect flexibility of the system was exemplified in the electric oven, which was heated on all sides top, and bottom, and the temperature of which could be regulated by turning on or off any part, or the whole of the current. Electrically heated hot-plates, flat-irons, and radiators were shown constructed on the same principle. Mr. Crompton also exhibited the latest form of Crompton potentiometer, for ratio measurements (accuracy 1 in 1,000,000), and simple forms of platinum thermometers for use with potentiometer.

A new instrument for testing the quality of iron in regard to magnetic hysteresis was exhibited by Prof. Ewing (Fig. 1). Its special use is to test sheet-iron for transformers and dynamo armatures. A few strips of the iron to be tested are cut to the length of three inches. These are clamped in a carrier, which is then caused to revolve between the poles of a magnet. The magnet is suspended on a knife-edge, and becomes deflected in consequence of the work expended in overcoming the magnetic hysteresis of the sample. The deflection is observed by means of a pointer, and serves as a measure of the hysteresis. The apparatus is so designed as to make the induction nearly the same in all specimens, notwithstanding differences of permeability. This makes its indications strictly a test of hysteresis.

Mr. L. Pyke showed an arrangement by means of which it is possible to obtain a greater efficiency in the reduction of the highly electro-positive metals from aqueous solutions, into and forming an amalgam with a mercury cathode.

A system of electric meters, viz., voltmeters, ammeters, and wattmeters, suitable for either direct or alternating currents, formed Major Holden's exhibit.

Prof. George Forbes exhibited a torsion model of submarine cable. A thread vertically suspended in oil represented the cable; the torsion (E.M.F.) being applied at the top by vanes and a positive or negative air blast (battery). The whole was suspended at the top by a spring (sending condenser); at the bottom was a mirror to reflect spot of light. This was controlled by a magnet (receiving condenser). Fluid friction represented resistance. Twist represented charge. The model gave signals compared with those of a cable 2000 miles long.

Specimens of the deposit or incrustation on the insulators of the electric light mains at St. Pancras, in which metallic sodium and potassium have been found, and of the insulators and wood bearers, which were in use on these mains, were exhibited by Major Cardew, R.E. The deposit was found to have been caused by the passage of alkaline salts in solution to the negative main, the salts being chiefly derived from the neighbouring soil, with which the end fibres of the wood bearers were in contact. Electrolysis of these salts took place with liberation of the metals at the negative main, the metals being oxidised and slowly carbonated in air. During this process nodules of the metal seem to have become embedded in the oxides, and preserved from oxidation.

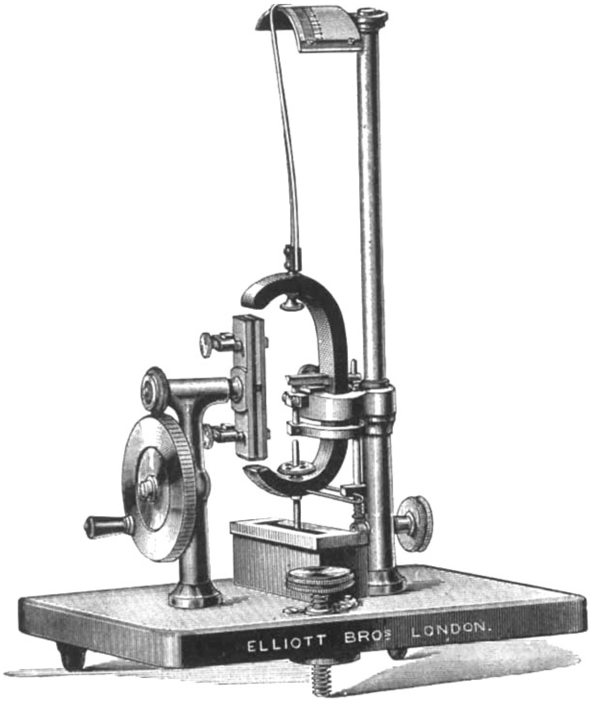

FIG. 1.

Mr. Francis Galton showed enlarged finger prints, with descriptive notation, and a print of the hand of a child eighty-six days old.

Prof. J. B. Farmer had on view examples of heterotypical nuclear division in reproductive tissues of plants.

Microscopic specimens illustrating some appearances of nerve-cells were exhibited by Dr. Gustav Mann; and wandering cells of the intestine were shown by Dr. Wesbrook and Mr. W. B. Hardy.

Mr. W. T. Burgess showed the results of experiments in connection with the transmission of infection by flies. Flies having been placed in momentary contact with a cultivation of *Bacillus prodigiosus* (or other suitable chromogenic organism) were allowed to escape into a large room. After some time they were recaptured and caused to walk, for a few seconds, over slices of sterile potatoes, which were then incubated for a few days. The experiments showed that the flies' tracks on the potatoes were marked by vigorous growths of the chromogenic organism, even when the flies spent several hours in constant activity before they were recaptured. The use of pathogenic organisms in these experiments would be attended with obvious dangers, but the results obtained with harmless microbes indicated the constant risks to which flies expose us.

Prof. Gotch and Dr. H. O. Forbes showed a living specimen of the *Malapterurus electricus* from the River Senegal; Mr. Stanley Kent, a new bacterial species; and Mr. D. Sharp, F.R.S., examples of variation in the size of beetles. In some beetles there is great difference in the size of adult individuals of the same species and sex. In one of the cases exhibited—*Brenthus anchorago*—this difference was, in length alone, nearly as five and one. It is believed that these extreme cases occur chiefly in forms in which the males are ornamented with "useless" appendages, *e.g.* the families Scarabæidæ, Lucanidæ, Brenthidæ.

The exhibit of the Marine Biological Association consisted of (1) marine organisms preserved in formic aldehyde, which, in dilute solutions, is specially useful for the preservation of transparent organisms as museum specimens; (2) a new method of fixing methylen-blue preparations. The methylen-blue preparations are fixed with ammonium molybdate. This method, due to Dr. Berthe, of Berlin, has the advantage of retaining the original blue colour of the preparations, and also of allowing the object to be mounted in balsam, or imbedded in paraffin in the usual way; (3) the action of light on the under sides of flat fishes. The flat fishes exhibited were reared in a tank with a flat slate bottom and glass front. Those portions of the under side of a fish which were not in contact with the slate, and to which light was accessible—this point being demonstrated by the exposure of a photographic plate upon which the fish lay—have become pigmented, whilst the remaining portions are without pigment; (4) living representatives of the Plymouth fauna.

A gradient indicator was exhibited by Mr. J. Wimshurst; and Sir Benjamin W. Richardson showed an electrical cabinet, for use in the wards of a hospital.

There were only two astronomical exhibits. Mr. J. Norman Lockyer, C.B., showed an enlargement of a photograph of the spectrum of α Orionis, taken with a 6-inch telescope and an objective prism of 45°.

Mr. Sidney Waters exhibited charts showing the distribution of the nebulæ and star-clusters, and their relation to the Milky Way. These charts, upon which are recorded the position of the 7840 objects of the New General Catalogue of 1888, were designed to show the distribution of the nebulæ and star-clusters, more especially in relation to the Milky Way. The resoluble and irresoluble nebulæ are shown to be most densely scattered in the poles of the galactic circle, and avoid the track of the Milky Way, while the star-clusters follow its course with great fidelity. The evidence derived from this distribution seems to point to some general connection between the nebular system and the system of the stars.

Prof. Ramsay had a spectroscope and Plücker tubes arranged to give ocular demonstration of the spectra of argon extracted from air, and of a mixture of argon and helium extracted from cleveite. It is hardly necessary to say that the spectroscope was in great demand all the evening.

Students' simple apparatus for determining the mechanical equivalent of heat was exhibited by Prof. Ayrton. The apparatus enables the heat equivalent of a watt-second to be experimentally ascertained with an error of less than 1 per cent., without any allowance having to be made for heat lost by conduction, convection, or radiation. It will give the result when 2000 c.c. of water are warmed for two minutes with a current of about 30 amperes, at a pressure of about 10 volts. The conductor consisted of 10 feet of manganin rolled into a thin strip to give off heat rapidly, and formed into a double grid so as to be used as an efficient water stirrer. The cross section of the flexible leads was such that practically no flow of heat occurred between them and the grid when a current of about 30 amperes is used.

Photographs of sections of gold nuggets etched to show crystalline structure, were exhibited by Prof. A. Liversidge. Gold nuggets, on being cut through or sliced and polished, and etched by chlorine water, were found to exhibit well-marked crystalline structure, closely resembling the Widmanstatt figures shown by most metallic meteorites, except that, in the nuggets, the crystals are more or less square in section, and show faces which evidently belong to the octahedron and cube.

Phenomena associated with the formation of cloud were experimentally illustrated by Mr. W. N. Shaw. Clouds formed by mixture of two currents of air of different temperatures were shown in a large glass globe. The currents were due to convection. The motion of the clouds gave an indication of the motion of the air. Under suitable conditions the motion assumed a gyratory or "cyclonic" character. A second globe was arranged to show the formation of a cloud by the dynamical cooling of air, consequent upon a sudden expansion equivalent to an elevation of about 10,000 feet. The water globules could be seen to fall slowly. A light was arranged at the back of the globe to show (under favourable circumstances) coloured coronæ surrounding a central bright spot. Two other globes were used in conjunction to demonstrate the modification which cloud formation introduces into the dynamical cooling of air. In one of the pair condensation diminished the fall of temperature incidental to sudden expansion, and the difference was indicated by the final pressure-difference between the globes.

There were two barometric exhibits, one a mechanical device for performing temperature corrections in barometers, by Dr. John Shields, and a new form of barometer, exhibited by Dr. J. Norman Collie.

The preparation of acetylene from calcic carbide was shown by Prof. V. B. Lewes. The combustion of acetylene for illuminating purposes attracted great attention. Calcic carbide, formed by the action of carbon on lime at the temperature of the electric furnace, was decomposed by water with evolution of acetylene. The remarkable brilliancy of the flame produced may be judged by the fact that the acetylene when consumed in suitable burners develops an illuminating value of 240 candles per 5 cubic feet of gas.

Generalised frequency curves were exhibited by the Applied Mathematics Department of University College, London, and also compound frequency curves, a harmonic analyser, and a biprojector.

Mr. T. Clarkson showed his circlographs for drawing and measuring circular curves of any large radius without requiring the centre, with examples of curves. The construction of these instruments is based upon a recent discovery that it is possible to cut a flat plate of steel (of uniform thickness and temper) into a certain form, which imparts to it the property of bending always into circular curves.

Mr. R. Inwards had on view examples of curious mortise joints in carpentry, all made without compression or veneering, and Mr. Hermann Kühne exhibited Junkers' patent calorimeter.

The radial cursor, a new addition to the slide rule, was shown by Mr. F. W. Lanchester. This cursor added to the slide rule makes the rule applicable at once to the calculation of whole or fractional powers, and renders it specially useful for the solution of problems in thermodynamics.

The Cambridge Scientific Instrument Company showed a new form of rocking microtome and a new form of spectrometer, and an improved form of Donkin's harmonograph. This was a modification of Donkin's harmonograph, and draws, on a moving strip of paper, a curve compounded of two simple harmonic motions.

During the evening demonstrations by means of the electric lantern took place in the meeting room.

Prof. A. C. Haddon showed lantern slides illustrating the ethnography of British New Guinea. The slides illustrated the physical characters of different tribes inhabiting British New Guinea, some of the occupations of the people, several kinds of dances, and the distribution of dance-masks. Evidence was given in support of the view that British New Guinea is inhabited by true dark Papuans, and by two distinct lighter Melanesian peoples, one of whom may have come from the New Hebrides, and the other from the Solomon Islands.

Lord Armstrong showed some of the results of his recent experiments on the electric discharge in air. The figures exhibited by means of the lantern, showed various phases, hitherto unobserved, of the brush discharge accompanying the electric spark. They showed also the remarkable modifying effect of induction on the results obtained. The luminous effects were delineated by instantaneous photography, and the mechanical effects by the electric action on dust plates. The spark itself had to be taken in a dark box on a shunt line, as its strong light and violent action would otherwise have been incompatible with the photographic and mechanical methods used in the experiments; but nearly the same tensions were obtained outside the box as within.

THE RARER METALS AND THEIR ALLOYS.[1]

II.

NOW turn to more complex curves taken on one plate by making the sensitised photographic plate seize the critical part of the curve, the range of the swing of the mirror from hot to cold being some sixty feet. The upper curve (Fig. 4) gives the freezing point of bismuth, and you see that surfusion, *a*, is clearly marked, the temperature at which bismuth freezes being 268°. The lower point represents the freezing point of tin, which we know is 231° C., and in it surfusion, *b*, is also clearly marked. The lowest curve of all contains a subordinate point in the cooling curve of standard gold, and this subordinate point, *c*, which you will observe is lower than the freezing point of tin, is caused by the falling out of solution of a small portion of bismuth, which alloyed itself with some gold atoms, and "fell out" below the freezing point not only of bismuth itself but of tin. Now gold with a low freezing point in it like this is found to be very brittle, and we are in a fair way to answer the question why $\frac{2}{10}$ per cent of zirconium doubles the strength of gold, while $\frac{2}{10}$ per cent of thallium, another rare metal, halves the strength. In the case of the zirconium the subordinate point is very high up, while in the case of the thallium it is very low down. So far as my experiments have as yet been carried, this seems to be a fact which underlies the whole question of the strength of metals and alloys. If the subordinate point is low, the metal will be weak; if it is high in relation to the main setting point, then the metal will be strong, and the conclusion of the whole matter is this.—The rarer metals which demand for their isolation from their oxides either the use of aluminium or the electric arc, never, so far as I can ascertain, produce low-freezing points when they are added in small quantities to those metals which are used for constructive purposes. The difficultly fusible rarer metals are never the cause

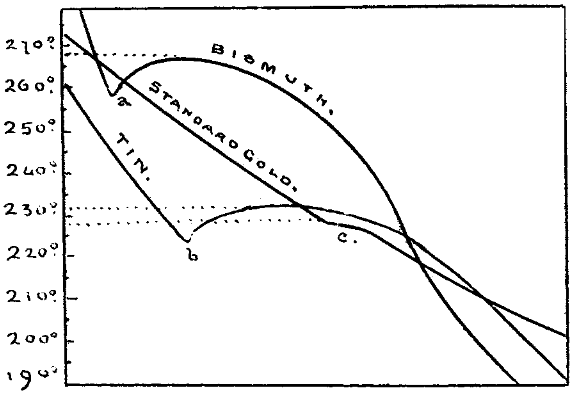

FIG. 4.

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[1] A Friday evening discourse, delivered at the Royal Institution on March 15, by Prof. Roberts-Austen, C.B., F.R.S. (Continued from p. 18.)